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**(54) Volume reducing adapter for power syringe**

Kraftangetriebene Spritze mit einem Adapter für Volumenverminderung

Seringue assistée avec adaptateur de réduction de volume

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**DE-A- 2 733 526** **FR-A- 2 381 527**  
**US-A- 4 006 736**

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## Description

The present invention relates to syringes for power injection of liquid materials, such as contrast media, into blood vessels to perform uroangiographic procedures.

The prior art, as exemplified in U.S. Patents No. 3623474, No. 3701345 and No. 4006736, contains several power injectors for operating plungers or pistons in syringes to supply liquid contrast media through catheters into blood vessels to enable the producing of X-ray images of organs or blood vessels thereof for medical diagnostic purposes. Generally, the syringes available for a power injector require a relatively large initial volume of contrast media, e.g., 125 or 95 milliliters, to operate properly on the power injector. Often only a portion of contrast media is used, particularly with the newer and more sensitive X-ray and other radiological equipment which is replacing older equipment. Unused contrast media is discarded resulting in unnecessary waste and higher contrast media costs. Existing power injector designs do not allow for their use with partially prefilled syringes.

FR-A-2381527 teaches a syringe for blood sampling having an adapter 26 for interlocking with the piston of the syringe. This adapter 26 includes rigid members which are aligned with and pushed through a notch 20. By then rotating adapter 26 along the piston's recessed portion 22, the piston and adapter 26 become interlocked. However, this design requires a somewhat complicated procedure to effect interlocking of the piston and adapter 26 which is also correspondingly time consuming.

The present invention seeks to provide a syringe for containing a reduced volume of contrast media and which is suitable for being utilised in existing power injectors.

The invention also seeks to avoid unnecessary costs associated with the manufacture, inventory and supply of different syringe sizes.

The present invention relates to a syringe suitable for a power injector wherein the volume of the syringe may be reduced by including an adapter having means on its forward end for gripping and engaging the backer plate of the conventional syringe piston and having on its rear end a machine grippable protrusion for being gripped and engaged by the plunger of the injector. The adapter has a selected length extending axially in the open end of the barrel of the syringe for advancing the position of the piston to define a predetermined reduced contents volume.

The invention is set forth in the appended Claims.

One advantage of the invention is that power injector syringes having different content volumes can be made from syringe barrels of the same size with standard pistons by inserting correspondingly different sizes of adapters which include gripping facilities on the front side for gripping and engaging the backer plate of the piston and which include a machine-grippable protrusion

on the rear side thereof for enabling proper operation of the reduced volume syringe by a power injector.

One feature of the invention is that angiography can be performed utilizing a power injector wherein contrast media syringes with smaller volumes of contrast media can be selected, for selected procedures.

Other objects, advantages and features of the invention will be apparent from the following description of the preferred embodiments taken in conjunction with the accompanying drawings, wherein:

Figure 1 is an elevational sectional view of a syringe for use in a power injector in accordance with the invention;

Figure 2 is a top view of an adapter in the syringe of Figure 1;

Figure 3 is an elevation view, taken from the right side of Figure 2, of a broken-away upper portion of the adapter of Figures 1 and 2;

Figure 4 is an elevation view taken from the front of Figure 2, of a broken-away portion including a clip element for securing the adapter to a backer plate; Figure 5 is a front elevation view of the adapter of Figures 1 and 2;

Figure 6 is a bottom view of the adapter of Figure 5; Figure 7 is a top view of a modified adapter for use in a syringe in accordance with the invention;

Figure 8 is a front elevation view of the adapter of Figure 7;

Figure 9 is a bottom view of the adapter of Figures 7 and 8; and

Figure 10 is a sectional view of a broken-away portion of a syringe containing the adapter of Figures 7, 8 and 9.

As shown in Figure 1, one embodiment of a syringe for a power injector in accordance with the invention includes a syringe barrel indicated generally at 30, a piston indicated generally at 32 within the barrel 30, and an adapter indicated generally at 34. The piston 32 has a rearward machine-grippable protrusion, such as button 36 on stem 38 which is engaged and gripped by the adapter 34. The adapter 34 has a similar machine-grippable protrusion such as button 40 on stem 42 on its rear end for being gripped by conventional piston engaging and gripping facilities (illustrated by dashed line 43) of a power injection machine 45. The length of the adapter 34, as shown by the arrowed line 44 is selected to advance the piston 32 into the barrel 30 of the syringe to define a predetermined reduced amount of volume in front of the piston in the barrel 30. In the absence of the adapter 34, the machine engaging protrusion 36 of the piston 32 generally must be adjacent to the open end 46 of the barrel in order to be engaged by the power injecting machine 45. However, the adapter 34 with its selected length allows the piston 32 to be displaced toward the nozzle end of the syringe by the distance 44 without disrupting the operation of the piston

engaging and gripping facilities 43 of the power injector 45.

The syringe barrel 30 is a conventional syringe barrel made of polypropylene or a co-polymer of polypropylene and polyethylene or other suitable material and preferably clear or translucent so that the presence of contents therein can be observed. Additionally, the barrel 30 may have conventional markings (not shown) on the exterior thereof indicating the quantity of liquid within the barrel. The upper end of the barrel 30 has a nozzle 48 with a conventional nut 50 threadably mounted thereon for securing a luer of a catheter (not shown) to the syringe in a conventional manner. While Figure 1 illustrates the nut 50 mounted on the nozzle 48, the nut 50 can, if desired, be provided as a separately packaged sterilized item. A flange 52 is provided on the open end 46 of the barrel for securing the syringe to the power injector machine 45 in a conventional manner.

The piston 32 includes a backer plate 60 formed of molded rigid plastics with a rear disc-like portion 66, on which the stem 38 and button 36 are centrally mounted, a cylindrical center portion 64 and an expanded forward portion 62. An elastomeric or rubber closure 68 is fitted over the forward portion 62, engaging in the cylindrical center portion 64. The outer edges of the cap 68 have three ringed portions 70, 72 and 73 which form a double seal with the barrel 30.

The adapter 34, as shown in Figures 2, 5 and 6, is formed from a molded plastics material, such as polypropylene or other polymer, which is preferably injection molded to the desired shape. The adapter 34 has a body portion 80 which is conveniently formed by a series of ribs 82 and a back plane 84 extending between a front disc 86 and a rear disc 88. The stem 42 and button 40 are formed centrally on the rear disc 88. The gripping facilities for engaging and gripping the backer plate 60 of the piston 32 include a pair of clips 90 and a pair of abutment members 92 extending forward from the front disc 86. The clips 90, as shown in Figure 4, have a neck portion 94 which defines a recess 96 for receiving the edge of the button 36 and an enlarged upper or head portion 98 which defines an edge 100 for engaging the forward or top surface of the button 36, as shown in Figure 1. Preferably, the surface 100 is undercut so as to form an angle 101 inclined downward, for example, 5°, so as to ensure that loss of resilience or engagement with the button 36 does not result in an upward sloped surface which can readily release the button 40 upon withdrawal of the adapter. Camming surfaces 102 are formed on the upper inner edges of the clips 90 for engaging the edges of the button 36 as the adapter 34 is moved forward against the piston 32 so that the clips 90 are readily flexed apart to permit button 36 to slip past the enlarged head portion 98 and to snap into position within the recess 96 to be held there by the edge 100. As shown in Figure 3, the abutments 92 have a trapezoidal configuration with a height selected to engage the surfaces of the rear portion 66 of the backer

plate concurrently with the engagement of the button 36 by the clips 90. The abutment members 92 are located on opposite sides of the clip members 90 for providing a stable base for power advancement of the piston 32.

A modified adapter 134 illustrated in Figures 7, 8, 9 and 10 has portions, identified by the same numerals as the embodiment of Figures 1-6, indicating similar structure and function. The adapter 134 contains modified clips 136 for engaging the button 36 of the plunger 32 and has modified abutments 138 mounted on the upper disc 86. The abutments 138 are small rectangular abutments, while the clips 136 are extended longitudinally from the rear to the back so as to accommodate an extended base 140 of the backer plate 60. The extended base 140 of the backer plate 60 is tapered so that the circular surface 142 which engages the modified adaptor 134 has a diameter which is smaller than the barrel diameter. The height of the clips 136 is made equal to the height of the abutments 138 so that the clips 136 can share in the applying and engaging force to the modified backer plate with the tapered extension 140. It is seen that the clips 136 and abutments 138 occupy a smaller circular area of the disc 86 corresponding to the smaller circular surface 142 on the tapered portion 140 of the backer plate.

The present invention provides substantial economic improvements in syringes for power injectors by including an adapter of a selected length to enable the economical production of reduced volume syringes, thus avoiding the cost and waste of unused contrast media that would normally not be used. The employment of the relatively low cost adapters avoids the expense of manufacture and inventory of various sizes of syringe barrels in order to supply power syringes with varying reduced quantities of injection fluid.

Since many modifications, variations and changes in detail can be made to the above described embodiments without departing from the scope and spirit of the invention, it is intended that all matter shown in the foregoing description and shown in the accompanying drawings be interpreted as only illustrating one or more embodiments of many possible embodiments of the invention and as not limiting the scope and spirit of the invention as defined in the following claims.

## Claims

1. An adapter (34; 134) for adjusting the internal volume of a power syringe containing a piston (32) having a machine-grippable protrusion (36, 38) thereon, said adapter comprising a generally elongate body configured for insertion into the cylindrical barrel (30) of said power syringe and comprising:

(a) a front disc (86) having centrally disposed on one side thereof, and extending outwardly from the adapter body, gripping means capa-

ble, in use, of engaging the machine-grippable protrusion (36, 38) on the piston (32) to maintain the adapter (34; 134) and the piston (32) in an abutting relationship;

(b) a rear disc (88) which is disposed coaxially with the front disc (86), said rear disc (88) having centrally disposed on one side thereof and extending outwardly from the adapter body a machine-grippable protrusion (40, 42) for engagement, in use, by the piston engaging and gripping means (43) of a power injector (45); and

(c) a central body portion (80) connecting said front disc (86) and said rear disc (88); characterised in that said gripping means comprises a pair of resilient clips (90; 136) for engaging and holding the machine-grippable protrusion (36, 38) on the piston (32) and a pair of abutment members (92; 138) located on opposite sides of the resilient clips (90; 136) and extending forward from the front disc (86) for engaging the rear of said piston.

2. An adapter according to claim 1, wherein each of the clips (90; 136) comprises a neck portion (94) defining a recess (96) for receiving the edge of a button (36) on the grippable protrusion of a piston and head portion (98) defining a ledge (100) for engaging a forward surface of said button (36).
3. An adapter according to claim 1 or claim 2, wherein the head portion (98) of each clip (90; 136) has an inwardly facing camming surface (102) disposed to bear on the edge of the button (36) of a machine grippable protrusion (36, 38) to force the clips (90; 136) apart as the adapter (34; 134) is brought into abutting contact with the piston (32).
4. An adapter according to any one of claims 1 to 3, wherein the machine grippable protrusion (42) extending outwardly from the rear disc (88) comprises a stem (42) having a button (40) affixed to the end thereof.
5. An adapter according to any one of claims 1 to 4, wherein the central body portion (80) comprises a back plane (84) and a plurality of ribs (82) extending between the front disc (86) and rear disc (88), said ribs (82) intersecting the back plane (84) at right angles.
6. A method of reducing the volume of a syringe of a type known per se containing a liquid contrast medium for use in uroangiographic procedures with a power injector (45) of a type known per se, said syringe including a piston (32) which slides within a cylindrical barrel (30) of said syringe and has a backer plate (60) with a machine grippable protrusion

(36, 38) thereon, and said power injector (45) having piston engaging and gripping means (43) for gripping and engaging the grippable protrusion (36,38) on said piston (32), which method comprises interposing between said piston (32) and said piston engaging and gripping means (43) an adapter (34; 134) according to claim 1 wherein said machine grippable protrusion (40, 42) on said rear disc (88) is engaged and gripped by said piston engaging and gripping means (43) of said power injector (45), said grippable protrusion (36,38) on said piston (32) is gripped by said pair of resilient clips (90; 136), and said backer plate (60) is engaged by said abutments (92).

7. A method according to claim 6, wherein each of the clips (90; 136) comprises a neck portion (94) defining a recess (96) for receiving the edge of a button (36) on the grippable protrusion of a piston and a head portion (98) defining a ledge (100) for engaging a forward surface of said button (36).
8. A method according to claim 6 or claim 7, wherein the head portion (98) of each clip (90; 136) has an inwardly facing camming surface (102) disposed to bear on the edge of the button (36) of a machine grippable protrusion (36, 38) and forces the clips (90; 136) apart as the adapter (34; 134) is brought into abutting contact with the piston (32).
9. A method according to any one of claims 6 to 8, wherein the machine grippable protrusion (42) extending outwardly from the rear disc (88) comprises a stem (42) having a button (40) affixed to the end thereof.
10. A method according to any one of claims 6 to 9, wherein the central body portion (80) comprises a back plane (84) and a plurality of ribs (82) extending between the front disc (86) and rear disc (88), said ribs (82) intersecting the back plane (84) at right angles.

#### Patentansprüche

1. Adapter (34; 134) zur Einstellung des Innenvolumens einer kraftbetriebenen Spritze, die einen Kolben (32) enthält, an dem ein maschinengreifbarer Vorsprung (36, 38) vorgesehen ist, wobei der Adapter einen insgesamt länglichen Körper umfaßt, der für ein Einsetzen in die zylindrische Hülse (30) der kraftbetriebenen Spritze ausgebildet ist und umfaßt:

(a) eine vordere Scheibe (86), an deren einen Seite eine sich von dem Adapterkörper nach außen erstreckende Greifeinrichtung zentral angeordnet ist, die im Einsatz mit dem maschi-

- nengreifbaren Vorsprung (36, 38) an dem Kolben (32) in Eingriff bringbar ist, um den Adapter (34; 134) und den Kolben (32) in anliegender Beziehung zu halten;
- (b) einer hinteren Scheibe (88), die koaxial zur vorderen Scheibe (86) angeordnet ist, wobei ein sich von dem Adapterkörper nach außen erstreckender maschinengreifbarer Vorsprung (40, 42) zentral an einer Seite der hinteren Scheibe (88) für einen Eingriff im Einsatz durch die Kolbeneingriffs- und Greifeinrichtung (43) einer kraftbetriebenen Einspritzeinrichtung (45) angeordnet ist; und
- (c) einen mittleren Körperabschnitt (80), der die vordere Scheibe (86) und die hintere Scheibe (88) miteinander verbindet; dadurch gekennzeichnet, daß die Greifeinrichtung ein Paar von elastischen Klipps (90; 136) für einen Eingreifen an dem maschinengreifbaren Vorsprung (36, 38) an dem Kolben (32) und ein Halten des maschinengreifbaren Vorsprungs (36, 38), und ein Paar Anschlagelemente (92; 138) umfaßt, die an entgegengesetzten Seiten der elastischen Klippse (90; 136) angeordnet sind und sich für ein Angreifen an der Rückseite des Kolbens von der vorderen Scheibe (86) aus nach vorne erstrecken.
2. Adapter nach Anspruch 1, bei dem jeder der Klippse (90; 136) einen Halsabschnitt (94), der eine Aussparung (96) für eine Aufnahme der Kante eines Knopfes (36) an dem greifbaren Vorsprung eines Kolbens bildet, und einen Kopfabschnitt (98) umfaßt, der einen Absatz (100) für ein Angreifen an einer vorderen Fläche des Knopfes (36) bildet.
  3. Adapter nach Anspruch 1 oder Anspruch 2, bei dem der Kopfabschnitt (98) jedes Klipps (90; 136) eine nach innen zeigende Nockenfläche (102) aufweist, die so angeordnet ist, daß sie auf die Kante des Knopfes (36) eines maschinengreifbaren Vorsprungs (36, 38) drückt, um die Klippse (90; 136) auseinanderzudrücken, wenn der Adapter (34; 134) in anliegenden Kontakt mit dem Kolben (32) gebracht wird.
  4. Adapter nach einem der Ansprüche 1 bis 3, bei dem der sich von der hinteren Scheibe (88) nach außen erstreckende maschinengreifbare Vorsprung (42) einen Schaft (42) umfaßt, an dessen Ende ein Knopf (40) befestigt ist.
  5. Adapter nach einem der Ansprüche 1 bis 4, bei dem der mittige Körperabschnitt (80) eine Rückebene (84) und mehrere Rippen (82) umfaßt, die sich zwischen der vorderen Scheibe (86) und der hinteren Scheibe (88) erstrecken, wobei die Rippen (82) die Rückebene (84) im rechten Winkel schneiden.
  6. Verfahren zur Reduzierung des Volumens einer an sich bekannten Spritze, die ein flüssiges Kontrastmittel für eine Verwendung bei uroangiographischen Verfahren mit einer an sich bekannten kraftbetriebenen Einspritzeinrichtung (45) enthält, wobei die Spritze einen Kolben (32) umfaßt, der innerhalb einer zylindrischen Hülse (30) der Spritze gleitet und eine Stützplatte (60) aufweist, an der ein maschinengreifbarer Vorsprung (36, 38) vorgesehen ist, und wobei die kraftbetriebene Einspritzeinrichtung (45) eine Kolbeneingriffs- und Greifeinrichtung (43) für ein Greifen des greifbaren Vorsprungs (36, 38) an dem Kolben (32) und einen Eingriff mit dem greifbaren Vorsprung (36, 38) aufweist, welches Verfahren das Anordnen eines Adapters (34; 134) nach Anspruch 1 zwischen dem Kolben (32) und die Kolbeneingriffs- und Greifeinrichtung (43) umfaßt, wobei der maschinengreifbare Vorsprung (40, 42) an der hinteren Scheibe (88) mit der Kolbeneingriffs- und Greifeinrichtung (43) der kraftbetriebenen Injektoreinrichtung (45) in Eingriff gebracht wird und von dieser gegriffen wird, der greifbare Vorsprung (36, 38) an dem Kolben (32) durch das Paar von elastischen Klippsen (90; 136) gegriffen wird, und die Anschläge (92) an der Stützplatte (60) angreifen.
  7. Verfahren nach Anspruch 6, bei dem jeder der Klipps (90; 136) einen Halsabschnitt (94), der eine Aussparung (96) für eine Aufnahme der Kante eines Knopfes (36) an dem greifbaren Vorsprung eines Kolbens bildet, und einen Kopfabschnitt (98) umfaßt, der einen Absatz (100) für ein Angreifen an einer Vorderfläche des Knopfes (36) bildet.
  8. Verfahren nach Anspruch 6 oder 7, bei dem der Kopfabschnitt (98) jedes Klipps (90; 136) eine nach innen zeigende Nockenfläche (102) aufweist, die so angeordnet ist, daß sie gegen die Kante des Knopfes (36) eines maschinengreifbaren Vorsprungs (36, 38) drückt und die Klipps (90; 136) auseinanderdrückt, wenn der Adapter (34; 134) in anliegenden Kontakt mit dem Kolben (32) gebracht wird.
  9. Verfahren nach einem der Ansprüche 6 bis 8, bei dem der sich von der hinteren Scheibe (88) nach außen erstreckende maschinengreifbare Vorsprung (42) einen Schaft (42) umfaßt, der einen Knopf (40) aufweist, der an seinem Ende befestigt ist.
  10. Verfahren nach einem der Ansprüche 6 bis 9, bei dem der mittlere Körperabschnitt (80) eine Rückebene (84) und eine Vielzahl von Rippen (82) umfaßt, die sich zwischen der vorderen Scheibe

(86) und der hinteren Scheibe (88) erstrecken, wobei die Rippen (82) die Rückebene (84) im rechten Winkel schneiden.

## Revendications

1. Adaptateur (34;134) pour régler le volume intérieur d'une seringue assistée contenant un piston (32) qui comporte une saillie à prise par machine (36, 38), ledit adaptateur comprenant un corps sensiblement allongé configuré pour insertion dans le tube cylindrique (30) de ladite seringue assistée, et comprenant :
  - (a) un disque avant (86) comportant, disposés centralement sur un de ses côtés et s'étendant vers l'extérieur à partir du corps de l'adaptateur, des moyens de prise qui peuvent s'accoupler, en utilisation, avec la saillie à prise par machine (36,38) du piston (32) afin de maintenir l'adaptateur (34;134) et le piston (32) en relation de butée mutuelle ;
  - (b) un disque arrière (88) qui est disposé coaxialement au disque avant (86), ledit disque arrière (88) comportant, disposée centralement sur un de ses côtés et s'étendant vers l'extérieur à partir du corps de l'adaptateur, une saillie à prise par machine (40,42) pour accouplement, en utilisation, avec des moyens d'attaque et de prise de piston (43) d'un injecteur d'assistance (45), et
  - (c) un corps central (80) reliant ledit disque avant (86) et ledit disque arrière (88) ; caractérisé en ce que lesdits moyens de prise comprennent une paire de griffes élastiques (90;136) pour venir en prise et retenir la saillie à prise par machine (36, 38) du piston (32), et une paire d'éléments de butée (92; 138) situés sur des côtés opposés des griffes élastiques (90;136) et s'étendant vers l'avant à partir du disque avant (86) de manière à attaquer l'arrière dudit piston.
2. Adaptateur suivant la revendication 1, dans lequel chacune des griffes (90;136) comprend une partie décollée (94) définissant un évidement (96) pour recevoir le bord d'un bouton (36) prévu sur la saillie de prise d'un piston, et une partie de tête (98) définissant un épaulement (100) pour venir en contact avec une surface avant dudit bouton (36).
3. Adaptateur suivant la revendication 1 ou la revendication 2, dans lequel la partie de tête (98) de chaque griffe (90;136) présente une surface de came tournée vers l'intérieur (102) et disposée de manière à appuyer sur le bord du bouton (36) d'une saillie à prise par machine (36,38) afin de forcer les griffes (90;136) à s'écarter l'une de l'autre lorsque

l'adaptateur (34;134) est amené en contact de butée avec le piston (32).

4. Adaptateur suivant une quelconque des revendications 1 à 3, dans lequel la saillie à prise par machine (42) s'étendant vers l'extérieur à partir du disque arrière (88) comprend une tige (42) à l'extrémité de laquelle est fixé un bouton (40).
5. Adaptateur suivant une quelconque des revendications 1 à 4, dans lequel le corps central (80) comprend un plan de renfort (84) et une pluralité de nervures (82) s'étendant entre le disque avant (86) et le disque arrière (88), lesdites nervures (82) coupant le plan de renfort (84) perpendiculairement.
6. Procédé de réduction du volume d'une seringue d'un type connu en lui-même contenant un milieu de contraste liquide pour utilisation dans des procédures uroangiographiques avec un injecteur d'assistance (45) d'un type connu en lui-même, ladite seringue comprenant un piston (32) qui coulisse dans un tube cylindrique (30) de ladite seringue et qui comporte une plaque de renfort (60) pourvue d'une saillie à prise par machine (36,38), et ledit injecteur d'assistance (45) comporte des moyens d'attaque et de prise de piston (43) pour saisir et venir en prise avec la saillie de prise (36,38) dudit piston (32), ledit procédé comprenant l'interposition, entre le dit piston (32) et les dits moyens d'attaque et de prise de piston (43), d'un adaptateur (34 ; 134) suivant la revendication 1, dans lequel la dite saillie à prise par machine (40, 42) sur le dit disque arrière (88) est attaquée et saisie par les dits moyens d'attaque et de prise de piston (43) du dit injecteur d'assistance (45), ladite saillie de prise (36, 38) du dit piston (32) est saisie par la dite paire de griffes élastiques (90 ; 136), et ladite plaque de renfort (60) est attaquée par lesdites butées (92).
7. Procédé suivant la revendication 6, dans lequel chacune des griffes (90 ; 136) comprend une partie décollée (94), définissant un évidement (96) pour recevoir le bord d'un bouton (36) prévu sur la saillie de prise d'un piston, et une partie de tête (98) définissant un épaulement (100) pour venir en contact avec une surface avant du dit bouton (36).
8. Procédé suivant la revendication 6 ou la revendication 7, dans lequel la partie de tête (98) de chaque griffe (90 ; 136) présente une surface de came tournée vers l'intérieur (102) et disposée de manière à appuyer sur le bord du bouton (36) d'une saillie à prise par machine (36, 38) afin de forcer les griffes (90 ; 136) à s'écarter l'une de l'autre lorsque l'adaptateur (34, 134) est amené en contact de butée avec le piston (32).

9. Procédé suivant une quelconque des revendications 6 à 8, dans lequel la saillie à prise par machine (42) s'étendant vers l'extérieur à partir du disque arrière (88) comprend une tige (42) à l'extrémité de laquelle est fixé un bouton (40).

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10. Procédé suivant une quelconque des revendications 6 à 9, dans lequel le corps central (80) comprend un plan de renfort (84) et une pluralité de nervures (82) s'étendant entre le disque avant (86) et le disque arrière (88), les dites nervures (82) coupant perpendiculairement le plan de renfort (84).

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FIG. 1

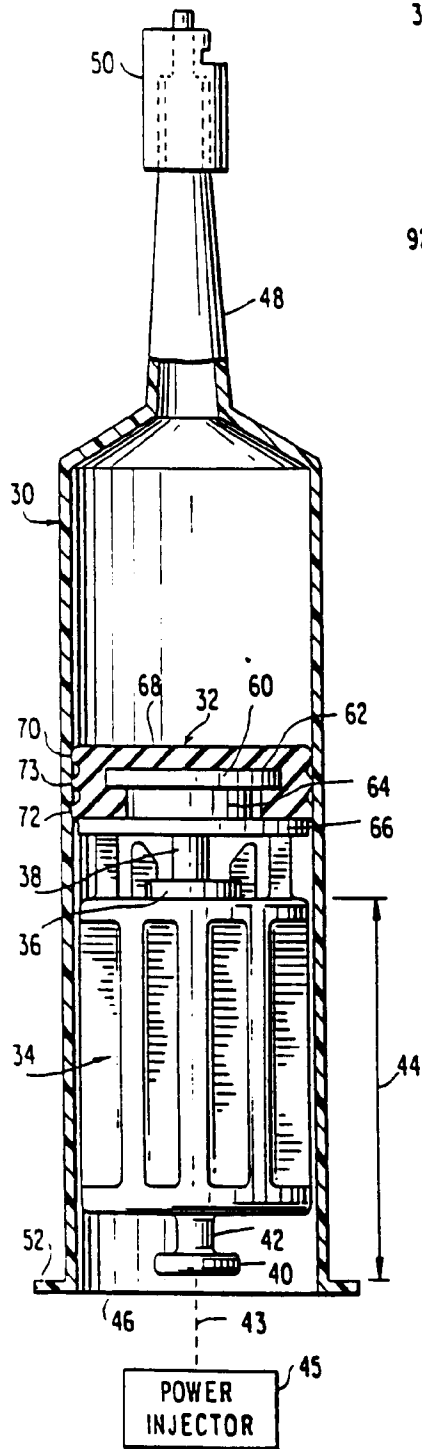


FIG. 2

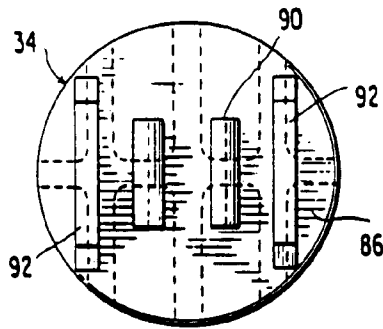


FIG. 3

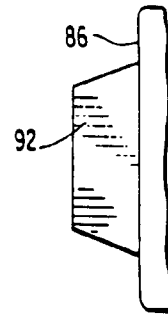


FIG. 4

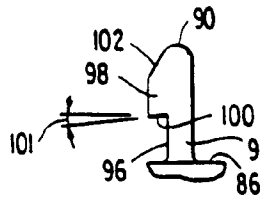


FIG. 5

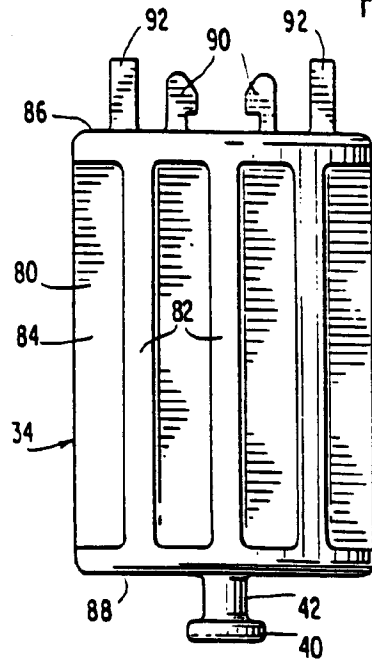


FIG. 6

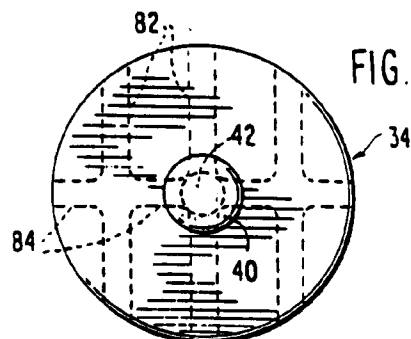




FIG. 7

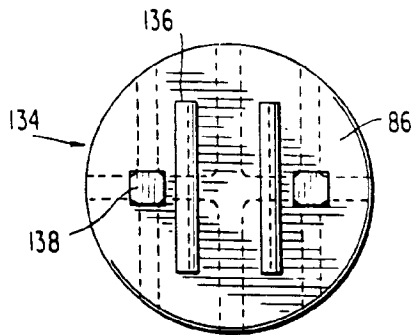


FIG. 8

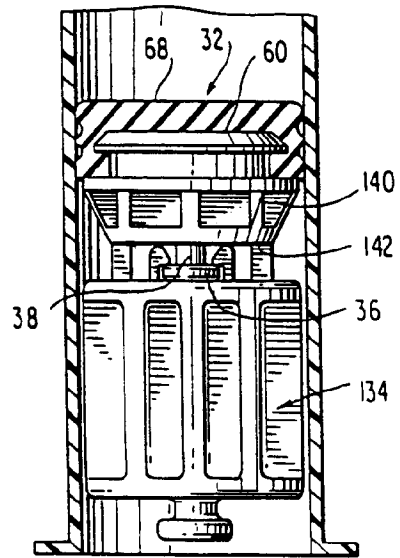
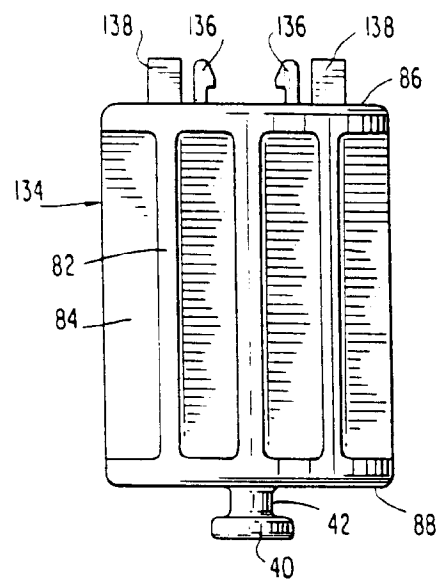


FIG. 10

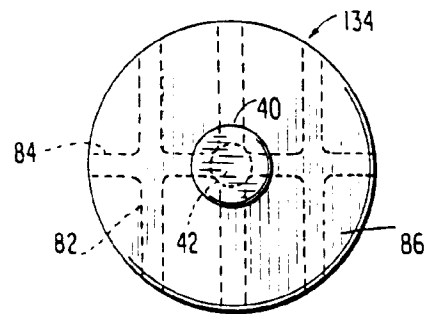


FIG. 9